Date of Issue:
17 December 2014

SAFETY DATA SHEET

1. Substance and Source Identification

Product Identifier

RM Number: 8988
RM Name: Titanium Dioxide Powder – Particle Size Distribution
Other Means of Identification: Not applicable.

Recommended Use of This Material and Restrictions of Use

This Reference Material (RM) is intended for use in the evaluation and calibration of equipment used to measure particle size distribution (PSD) values in the 0.1 µm to 0.5 µm particle diameter range. The PSD values were measured using laser light scattering (LLS) and X-ray disc centrifugation (XDC), two common methods for PSD value determination. A unit of RM 8988 consists of a single bottle containing approximately 6 g of rutile titanium dioxide powder.

Company Information

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

Telephone: 301-975-2200
FAX: 301-948-3730
E-mail: SRMMSDS@nist.gov
Website: http://www.nist.gov/srm

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

2. Hazards Identification

Classification

Physical Hazard: Not Classified.
Health Hazard: Carcinogenicity, Category 2

Label Elements

Symbol

Signal Word
WARNING

Hazard Statement(s)

H351	Suspected of causing cancer (inhalation).

Precautionary Statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P280	Wear protective gloves, eye protection, and protective clothing.
P308+P313	If exposed or concerned: get medical attention.
P405	Store locked up.
P501	Dispose of contents and container according to local regulations.

Hazards Not Otherwise Classified: None.

Ingredients(s) with Unknown Acute Toxicity: None.

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Substance: Titanium dioxide.

Other Designations: Titanium oxide; TiO_2; Titanium peroxide; brookite; rutile; (TI-Pure®; RPD Vantage®; rutile paper dry)[(1)].

Components are listed in compliance with OSHA's 29 CFR 1910.1200.

Hazardous Component(s)[(a)]	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Titanium Dioxide	13463-67-7	236-675-5	80 – 98
Aluminum Hydroxide	21645-51-2	244-492-7	0 – 9
Amorphous Silica	7631-86-9	231-545-4	0 – 11

[(a)] Composition for this material is DuPont proprietary.

4. FIRST AID MEASURES

Description of First Aid Measures

Inhalation: If adverse effects occur, remove to well-ventilated (uncontaminated) area. If breathing is difficult, qualified personnel may administer oxygen. If not breathing, qualified personnel should give artificial respiration. Seek immediate medical attention.

Skin Contact: Rinse affected skin with water for at least 15 minutes, then wash thoroughly with soap or mild detergent and water. If skin irritation persists, seek medical aid and bring the container or label.

Eye Contact: Immediately flush eyes, including under the eyelids, with copious amounts of water for at least 15 minutes. Seek immediate medical attention.

Ingestion: If a large amount is swallowed, seek medical attention.

Most Important Symptoms/Effects, Acute and Delayed: Irritation, cough, difficulty breathing, cancer (suspect).

Indication of any immediate medical attention and special treatment needed, if necessary: If any of the above symptoms are present, seek immediate medical attention.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Negligible fire hazard.

Extinguishing Media

Suitable: Use extinguishing agents appropriate for surrounding fire.

Unsuitable: Not applicable.

Specific Hazards Arising from the Chemical: Not applicable.

Special Protective Equipment and Precautions for Fire-Fighters: Move container from fire area if it can be done without personal risk. Avoid inhalation of material or combustion by-products. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

NFPA Ratings (0 = Minimal; 1 = Slight; 2 = Moderate; 3 = Serious; 4 = Severe)

Health = 1 Fire = 0 Reactivity = 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: Collect spilled material in appropriate container for disposal. See Section 8, "Exposure Controls and Personal Protection".

Methods and Materials for Containment and Clean up: Stop spill if possible without personal risk.

7. HANDLING AND STORAGE

Safe Handling Precautions: Avoid generating dust. See Section 8, "Exposure Controls and Personal Protection".

[(1)] Certain commercial equipment, instrumentation, or materials are identified in this Safety Data Sheet to adequately specify the material. Such identification does not imply recommendation or endorsement by NIST, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Storage and Incompatible Materials: Store in a well-ventilated area. Keep separated from incompatible substances (see Section 10, "Stability and Reactivity").

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits

Components	OSHA (PEL)	ACGIH (TLV)	NIOSH (REL)
Titanium dioxide	15 mg/m^3 TWA (total dust) 5 mg/m^3 TWA (respirable dust)[(a)]	10 mg/m^3 TWA	5000 mg/m^3 IDLH
Silicon dioxide	20 mppcf TWA (80)/(% SiO2) mg/m^3 TWA	No occupational exposure limits established.	6 mg/m^3 TWA 3000 mg/m^3 IDLH
Aluminum Hydroxide	No occupational exposure limits established.		

[(a)]Particulates not otherwise regulated.

Engineering Controls: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Personal Protection Measures: In accordance with OSHA 29 CFR 1910.132, subpart I, wear appropriate Personal Protective Equipment (PPE) to minimize exposure to this material.

Respiratory Protection: If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29CFR 1910.134 must be followed. Refer to NIOSH 42 CFR 84 for applicable certified respirators.

Eye Protection: Eye protection is not required but recommended.

Skin and Body Protection: Protective clothing and gloves are not required but recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Descriptive Properties	Titanium Dioxide (80 % to 98 %)	Aluminum Hydroxide (0 % to 9 %)	Amorphous Silica (0 % to 11 %)
Molar Mass (g/mol):	79.88	78.00	60.09
Molecular Formula:	TiO_2	$Al(OH)_3$	SiO_2
Appearance (physical state, color, etc.):	white or black, solid, fine powder	white, solid, fine powder	white, solid, fine powder
Odor:	odorless	not available	odorless
Odor threshold:	not applicable	not available	not applicable
pH:	neutral	5.5 to 8.0	3.5 to 4.4 (4 % dispersion)
Evaporation rate:	not applicable	not applicable	not applicable
Melting point/freezing point:	1825 °C to 1850 °C (3317 °F to 3362 °F)	not available	>1600 °C (>2912 °F)
Relative Density as Specific Gravity (water = 1)**:**	3.84 to 4.26	2.423	2.19 to 2.66
Vapor Pressure:	not applicable	not applicable	not applicable
Vapor Density (air = 1):	not applicable	not applicable	not applicable
Viscosity:	not applicable	not applicable	not applicable
Solubilities:	Insoluble: water, hydrochloric acid, nitric acid, dilute sulfuric acid; Soluble: hot sulfuric acid, hydrofluoric acid, alkali	Insoluble: water, alcohol; Soluble: alkali solutions, mineral acids	insoluble: water, acids; soluble: hydrofluoric acid, molten alkali when finely divided
Partition coefficient (n-octanol/water):	not available	not available	not available

Thermal Stability Properties	Titanium Dioxide (80 % to 98 %)	Aluminum Hydroxide (0 % to 9 %)	Amorphous Silica (0 % to 11 %)
Autoignition Temperature:	not applicable	not applicable	not applicable
Thermal Decomposition:	not applicable	not applicable	not applicable
Initial boiling point and boiling range:	2500 °C to 3000 °C (4532 °F to 5432 °F)	not applicable	2230 °C (4046 °F)
Explosive Limits, LEL:	not applicable	not applicable	not applicable
Explosive Limits, UEL:	not applicable	not applicable	not applicable
Flash Point:	not applicable	not applicable	not applicable
Flammability (solid, gas):	not applicable	not applicable	not applicable

10. STABILITY AND REACTIVITY

Reactivity: This material is not reactive at normal temperatures and pressure.

Stability: X Stable _____ Unstable

Possible Hazardous Reactions: Not applicable.

Conditions to Avoid: Generating dust.

Incompatible Materials: Metals, halo carbons, halogens, acids, combustible materials, metal salts, oxidizing materials.

Hazardous Decomposition: Oxides of titanium, miscellaneous decomposition products.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Exposure: X Inhalation _____ Skin X Ingestion

Symptoms Related to the Physical, Chemical and Toxicological Characteristics: Irritation with coughing and sneezing. Respiratory disorders may be affected by silicon dioxide content. Kidney disorders and liver disorders may be affected due to aluminum hydroxide content.

Potential Health Effects (Acute, Chronic, and Delayed)

Inhalation: Irritation with coughing and sneezing as a nuisance dust. Long term exposure may cause pulmonary irritation with cough, difficulty breathing, a decline pulmonary function, and x-ray evidence of mild fibrosis. Rats showed small focal areas of emphysema attributed to large amounts of dust. Bronchial adenomas and non-neoplastic pulmonary keratinizing cysts occurred at the 250 mg/m^3 level. Long-term exposure to fibrous silica dust may result in silicosis with symptoms of dyspnea, tachypnea, marked weakness, and weight loss.

Skin Contact: May cause occlusion and miliaria. Prolonged contact with silicon dioxide may cause drying of the skin.

Eye Contact: Mechanical irritation with redness and pain.

Ingestion: Large quantities may cause intestinal obstruction; no other adverse effects identified.

Numerical Measures of Toxicity

Acute Toxicity: Not classified.

Titanium dioxide: Rat, Oral, LD50: >10 000 mg/kg
Aluminum hydroxide: Rat, Oral, LD50: >5000 mg/kg
Silicon dioxide: Rat, Oral, LD50: >5000 mg/kg
Rat, Inhalation, LC50: >2.2 mg/L (1 h)
Rabbit, Dermal, LD50: 2000 mg/kg

Skin Corrosion/Irritation: Not classified.
Titanium dioxide: Human, skin 300 µg, (3 d) intermittent, mild effects reported.

Serious Eye Damage/Eye Irritation: Not classified.
Silicon dioxide: Rabbit, eyes 25 mg (24 h) mild.

Respiratory sensitization: No data available.

Skin sensitization: No data available.

Germ Cell Mutagenicity: No data available.

Carcinogenicity: Category 2.

Listed as a Carcinogen/Potential Carcinogen X **Yes** _____ **No**

IARC lists titanium dioxide as Group 2b, *possibly carcinogenic to humans*.
IARC lists silicon dioxide as Group 3, *not classifiable*.

Mutagenic data:
Titanium dioxide: Hamster, 500 mg/L.

Tumorigenic data:
Titanium dioxide: Rat, Inhalation, TCLo, 250 mg/m^3 (6 h over 2 years, intermittent).

Reproductive Toxicity: Not classified.
Aluminum hydroxide: Woman, Oral, TDLo, 84 g/kg (pregnant 1 to 40 weeks).

Specific target organ toxicity, single exposure: No data available.

Specific target organ toxicity, repeated exposure: Not classified.
Silicon dioxide: Long-term exposure to fibrous silicon dioxide dusts may cause silicosis.

Aspiration hazard: No data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data

Silicon dioxide:
Fish, Zebrafish, *Brachydanio rerio*, LC50: 5000 mg/L, static, (96 h).
Algae, *Pseudokirchneriella subcapitata*, EC50: 440 mg/L (72 h).
Invertebrate, water flea, *Ceriodaphnia dubia*, EC50: 7600 mg/L (48 h).

Persistence and Degradability: No data available.

Bioaccumulative Potential: No bioaccumulation expected for silicon dioxide.

Mobility in Soil: No data available.

Other Adverse effects: No data available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose in accordance with all applicable federal, state, and local regulations.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Not regulated by DOT or IATA.

15. REGULATORY INFORMATION

U.S. Regulations

CERCLA Sections 102a/103 (40 CFR 302.4): Not regulated.

SARA Title III Section 302 (40 CFR 355.30): Not regulated.

SARA Title III Section 304 (40 CFR 355.40): Not regulated.

SARA Title III Section 313 (40 CFR 372.65): Not regulated.

OSHA Process Safety (29 CFR 1910.119): Not regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21)

ACUTE HEALTH:	No
CHRONIC HEALTH:	Yes
FIRE:	No
REACTIVE:	No
PRESSURE:	No

State Regulations

California Proposition 65: Warning! This product contains a chemical (titanium dioxide) known to the state of California to cause cancer.

U.S. TSCA Inventory: Titanium dioxide, aluminum hydroxide, and silicon dioxide are listed.

TSCA 12(b), Export Notification: Not listed.

Canadian Regulations: WHMIS Information is not provided for this material.

16. OTHER INFORMATION

Issue Date: 17 December 2014

Sources: Du Pont Titanium Technologies, MSDS "*TI-PURE" Titanium Dioxide Pigment*, 15 February 2007.

ChemADVISOR, Inc., SDS *Titanium Dioxide*, 10 September 2014.

ChemADVISOR, Inc., SDS *Aluminum Hydroxide*, 10 September 2014.

ChemADVISOR, Inc., SDS *Silicon Dioxide*, 10 September 2014.

Key of Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists	NTP	National Toxicology Program
CAS	Chemical Abstracts Service	OSHA	Occupational Safety and Health Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PEL	Permissible Exposure Limit
CFR	Code of Federal Regulations	RCRA	Resource Conservation and Recovery Act
DOT	Department of Transportation	REL	Recommended Exposure Limit
EINECS	European Inventory of Existing Commercial Chemical Substances	RQ	Reportable Quantity
EPCRA	Emergency Planning and Community Right-to-Know Act	RTECS	Registry of Toxic Effects of Chemical Substances
IARC	International Agency for Research on Cancer	SARA	Superfund Amendments and Reauthorization Act
IATA	International Air Transportation Agency	SCBA	Self-Contained Breathing Apparatus
IDLH	Immediately Dangerous to Life and Health	SRM	Standard Reference Material
LC50	Lethal Concentration	STEL	Short Term Exposure Limit
LD50	Median Lethal Dose or Lethal Dose, 50 %	TLV	Threshold Limit Value
LEL	Lower Explosive Limit	TPQ	Threshold Planning Quantity
MSDS	Material Safety Data Sheet	TSCA	Toxic Substances Control Act
NFPA	National Fire Protection Association	TWA	Time Weighted Average
NIOSH	National Institute for Occupational Safety and Health	UEL	Upper Explosive Limit
NIST	National Institute of Standards and Technology	WHMIS	Workplace Hazardous Materials Information System

Disclaimer: Physical and chemical data contained in this SDS are provided only for use in assessing the hazardous nature of the material. The SDS was prepared carefully, using current references; however, NIST does not certify the data in the SDS. The values for this material are given in the NIST Report of Investigation.

Users of this RM should ensure that the SDS in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srmmsds@nist.gov; or via the Internet at http://www.nist.gov/srm.